Thermal Control Subsystem FAME

PRELIMINARY TEMPERATURE PREDICTIONS

- ASSUMPTIONS
- CASES
- RESULTS
- CONCLUSIONS
- FORWARD WORK

ASSUMPTIONS

- ALTITUDE = 19323.4 NM
- ENVIRONMENTAL CONSTANTS:
  SOLAR = 444 W/in^2 ALBEDO = .28% IR = 70 W/in^2
- BLANKET α/ε = .37/.78
- SCT α/ε = .10/.85
- TRIM TABS:
  - TILTED 45º FROM SPIN AXIS.
  - SCT ON BOTH SIDES – NO BLANKETS.
- SHEET METAL SUN SHADE WITH SCT ON EXPOSED SIDES – DEPENDING ON CASE.
- SOLAR PANELS:
  - 24.72% SOLAR CELL COVERAGE IN NO PITCH CASE.
  - 34.9% SOLAR CELL COVERAGE IN 10º PITCH CASE.
  - UNPOPULATED/UNBLANKETED AREA IS SCT.

CASES

- PANELS NORMAL TO SPIN AXIS
- PANELS PITCHED 10º TOWARD INSTRUMENT
- PANELS AND SUNSHADE BLANKETED
- PANELS AND SUNSHADE UNBLANKETED

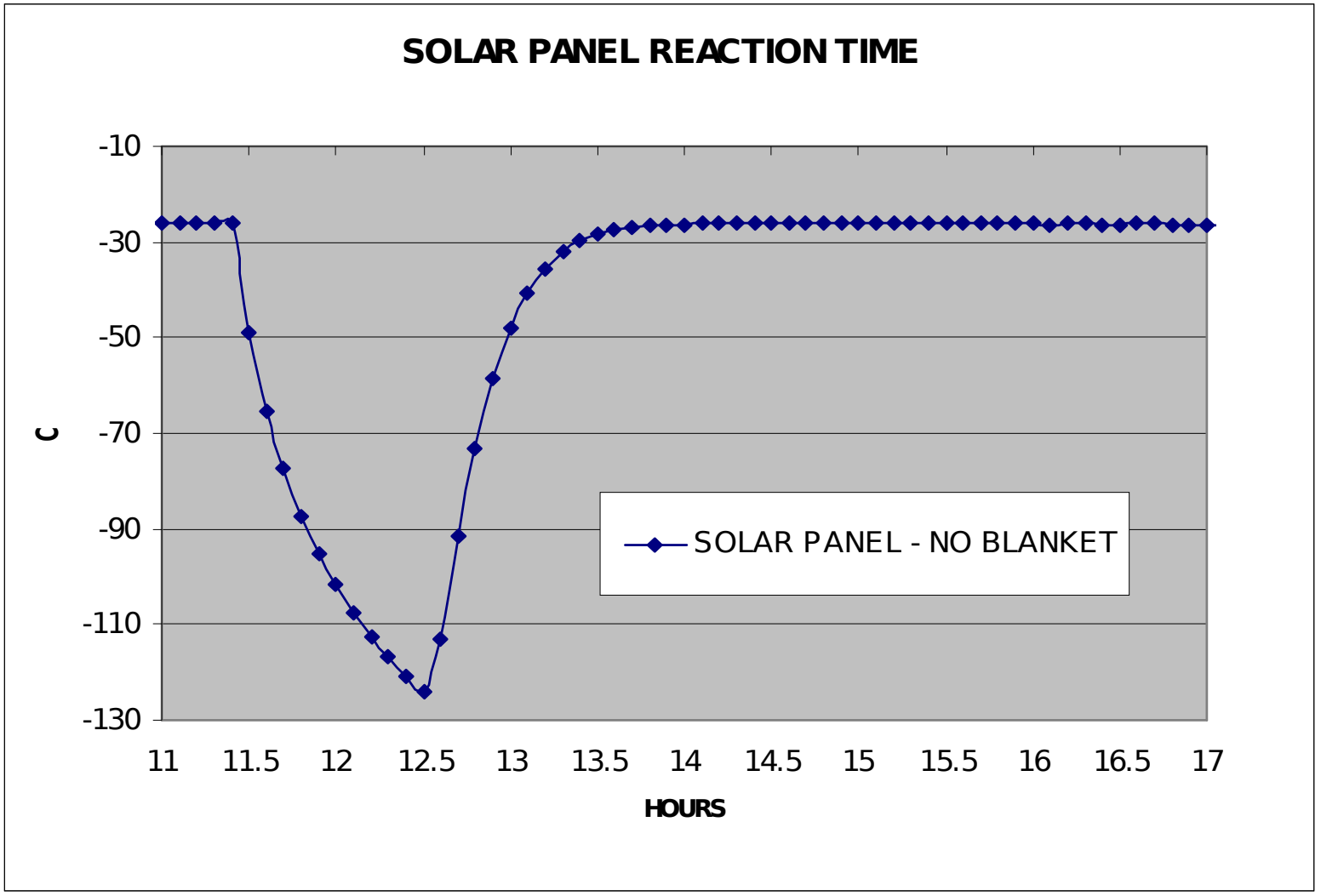
RESULTS

(1 of 6)

	S/C	S/A		Sun Shield		
CASE STUDY	BUS MLI	Sun Side	Shade Side	Sun Side	Shade Side	Trim Tabs
CASE 1 - NO PITCH w/ MLI						
Solar Cells Cover 24.72% of S/A	-165	-5	-142	-70	-162	n/a
Orbital Min/Max	n/a	n/a	n/a	n/a	n/a	-150 / -78
CASE 2 - NO PITCH w/o MLI						
Solar Cells Cover 24.72% of S/A	-101	-40	-41	-91	-92	n/a
Orbital Min/Max	n/a	n/a	n/a	n/a	n/a	-115 / -85
CASE 3 - 10º PITCH w/ MLI						
Solar Cells Cover 34.9% of S/A	-163	18	-132	-65	-170	n/a
Orbital Min/Max	n/a	19 / 17	n/a	-68 / -62	n/a	-150 / -78
CASE 4 - 10º PITCH w/o MLI						
Solar Cells Cover 34.9% of S/A	-90	-25	-26	-91	-92	n/a
Orbital Min/Max	n/a	-28 / -22	-29 / -23	-97 / -85	-98 / -86	-112 / -83

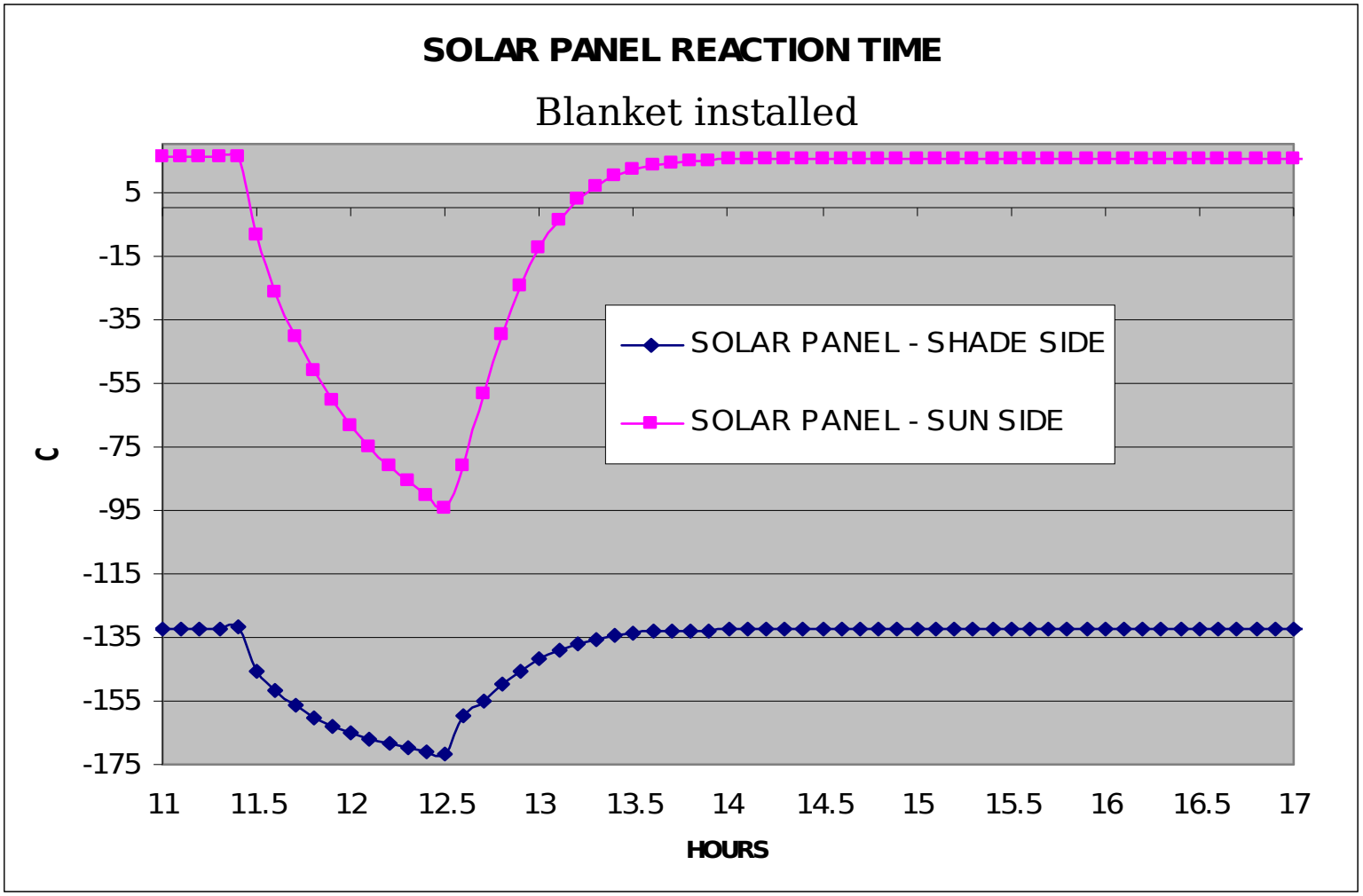
Results

(2 of 6)

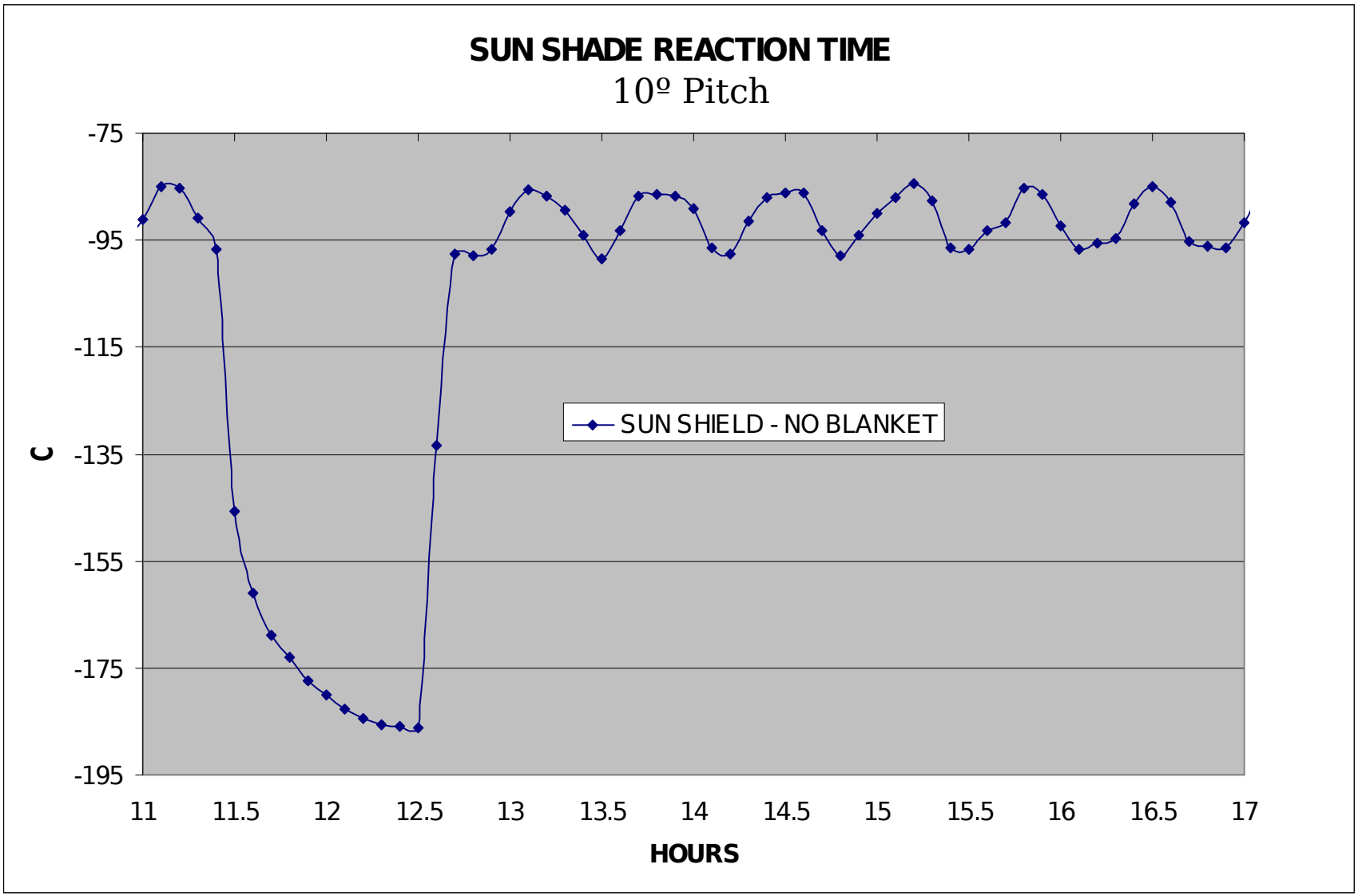


Results

(3 of 6)



Results
(4 of 6)



Results

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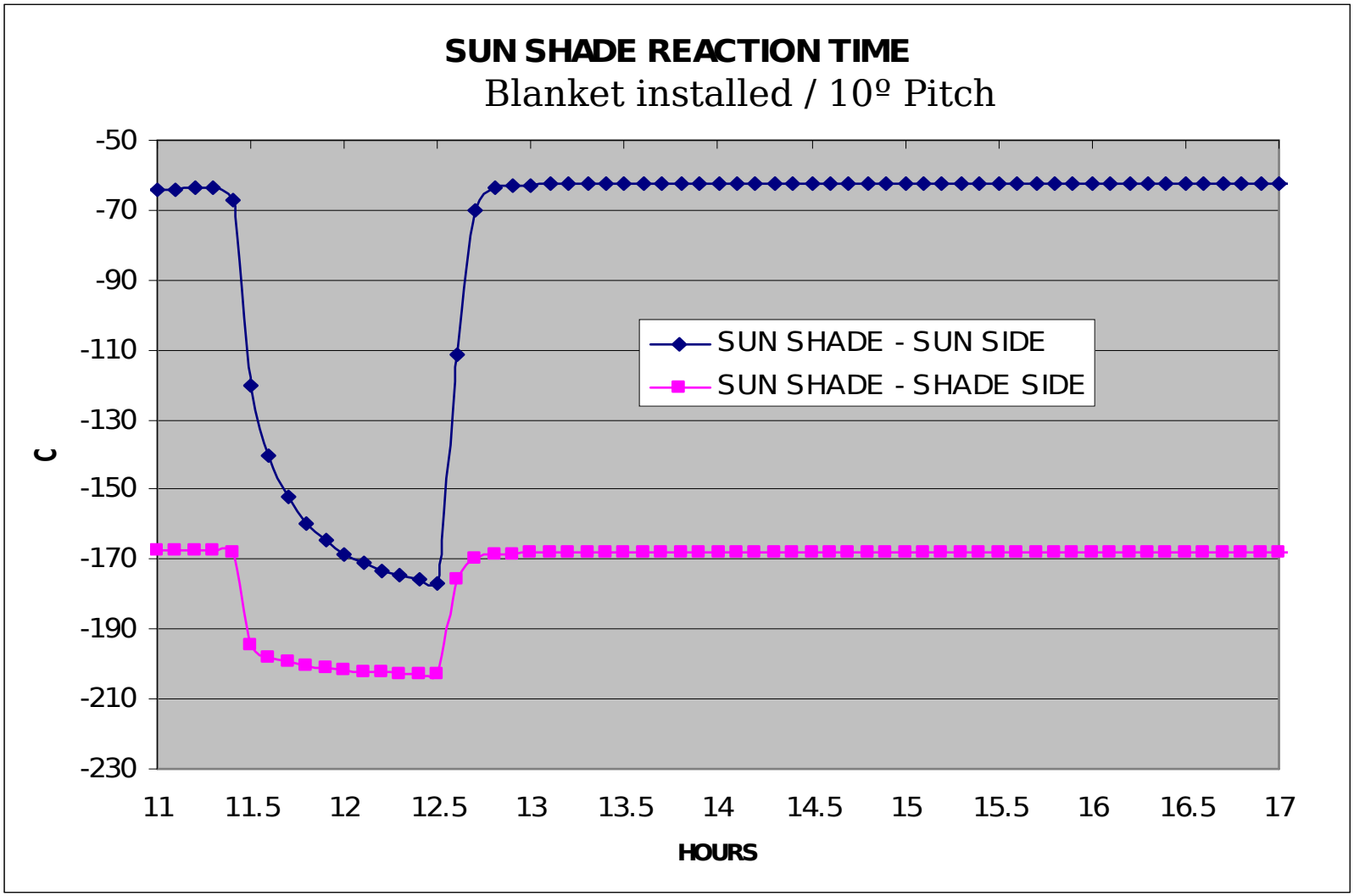

Results

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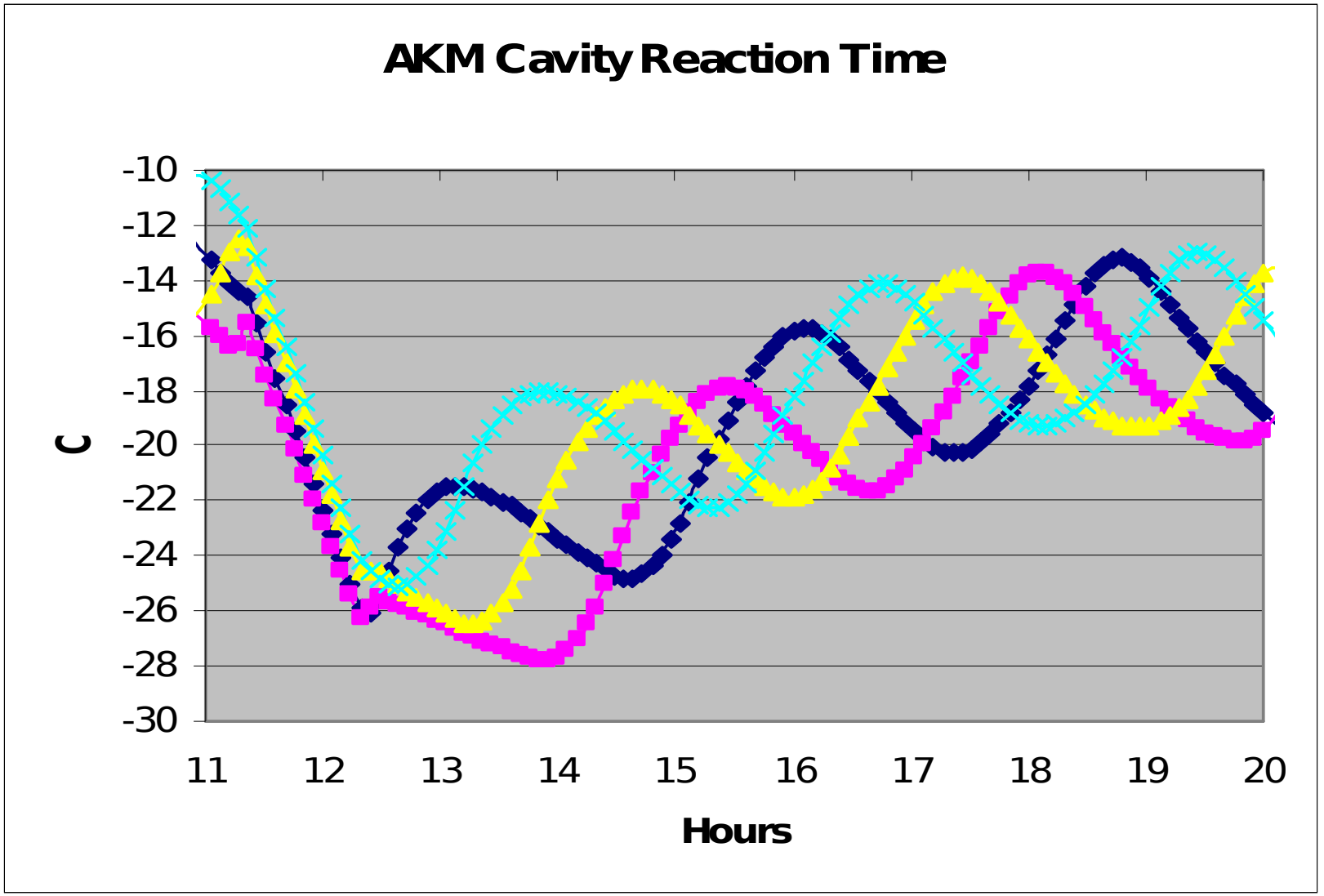

CONCLUSIONS

- Trim Tab temperature swing less severe when panels are blanketed.
  - May have biggest impact on instrument since temperature swing will be apparent over entire mission – view to instrument.
- About 3 hours for the vehicle temperature to return to pre-eclipse state (passively).
  - Vehicle stability an affected yet separate issue.
- Blankets on sun shield and panels cause more severe temperature changes during eclipse for those components.

  NO MLI / with MLI
  - 100 vs 113ºC ΔT for solar panels.
  - 90 vs 113ºC ΔT for sun shield.
- I have a lot of work to do……(see next slide).

FORWARD WORK
(1 of 2)

- Begin running worst hot/cold cases.
  - Worst case environmental constants, blanket emissivities, BOL/EOL material properties, min/max line voltages.
- Size electronics deck radiator.
  - This will determine required Heater circuit dissipations /number of circuits.
  - Thermal time constant – Reaction time to regain stability.
  - Box layout on deck.
- Add detail to Instrument.
  - In order to attain Interface Heater/Conductance requirement.
  - Predict star tracker interface/heater requirement.
  - Get fluxes on Instrument apertures.
  - Antenna temperature prediction for required test limits.

FORWARD WORK
(2 of 2)

- Incorporate realistic solar cell layout.
- Geometry changes
  - Trim Tab/Bus size.
  - Box layout
- Verify all conductors/masses